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A MEASURE OF MUTUAL FUND PERFORMANCE IN CANADA

by

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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled A MEASURE OF MUTUAL FUND PERFORMANCE IN CANADA submitted by JUGINDER DHINGRA in partial fulfillment of the requirements for the degree of Master of Business Administration.

ABSTRACT

This study is an attempt to evaluate the performance of mutual funds by combining annual yield and variability of annual yields into a single index of performance which is consistent with recent developments of capital asset theory. Similar studies have previously been performed in the U. S. The present study is an analysis of Canadian mutual funds.

Of particular interest are the hypotheses that (1) greater variability in yields is associated with higher average yields, (2) that there is a significant relationship between average yield and variability which is approximately linear, (3) that differences in performance persist through time, (4) that funds attempt to remain in given risk classes, as measured by variability in yield, (5) that the average Canadian mutual fund performs as well as a portfolio like the Toronto Stock Exchange Industrial Average.

The study is based on the performance of twenty-two funds during the period 1954 to 1969.

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CHAPTER 1

INTRODUCTION

Recent advances in portfolio selection theory,[1] the theory of capital asset prices,[2] and the behavior of stock market prices[3] have had implications for the evaluation of mutual fund performance. This is particularly true of Sharpe's work on capital asset prices.[4] The theory developed by Sharpe is based upon the presumption that investors are willing to choose among alternative investments based upon two parameters of the probability distribution of the returns, the mean and standard deviation. The theory is explained with reference to an E/σ diagram where the expected return is plotted along the horizontal axis and the standard deviation of returns along the vertical axis. Any investment such as a particular stock is represented by a point in the diagram.

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[1]H. Markowitz, "Portfolio Selection," Journal of Finance, Vol. XII (March, 1952), pp. 71-91.

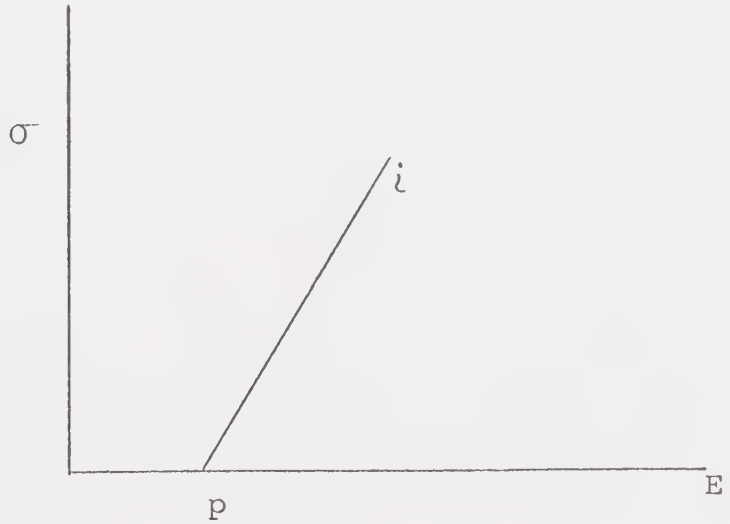
[2]William F. Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," Journal of Finance, Vol. XIX (September, 1964), pp. 425-442.

[3]Eugene F. Fama, "The Behavior of Stock Market Prices," Journal of Business, Vol. XXXVIII (January, 1965), pp. 34-105.

[4]Sharpe, op. cit., pp. 429-442.

Sharpe makes three important assumptions: (1) Investors are risk averters, i.e. they prefer less risk to more, which in the context of the theory is measured by σ. This implies that of two securities with the same expected return they prefer that with the lesser standard deviation, or similarly of two securities with the same risk they prefer that with the higher expected return. (2) Investors can borrow and lend money to the extent desired at a common risk free interest rate. (3) All investors have the same predictions for the future E/σ combinations of the various securities.

Sharpe demonstrates that under these assumptions all efficient portfolios will fall along a straight line in the E/σ diagram.[5] The essence of the argument is the following: By investing in a given asset i and lending at the pure rate p an investor can attain any E/σ point along the line pi, and



[5]Efficient means non-dominated, i.e. those portfolios whose alternatives do not include E/σ combinations with either the same E and a lower σ, or the same σ and a higher E, or a higher E and a lower σ.

by borrowing and investing in i,any point along the extension of pi. Given that investors strive for greater E and lower $\bar{\sigma}$ stocks, any E/$\bar{\sigma}$ combination below and to the right of i would be more desirable. If such a stock was available investors would purchase it instead of i,driving its price up and that of i down until both stocks were equally desirable. This would occur when they both fell along the line pi. Since this comparison is analogous for more securities the conclusion is that if more than one portfolio or stock is efficient it would lie on the line also.

By allocating his money between p and i,an investor can attain any point on the line

$$E = p + [(Ei-p)/\bar{\sigma}_i]\ \bar{\sigma}$$

where the slope[6] of the line is given by $(E_i-p)/\bar{\sigma}_i$. The higher $(E_i-p)/\bar{\sigma}_i$,the flatter the line, i.e. further down and to the right. Thus more desirable E/$\bar{\sigma}$ points would be associated with flatter lines, the most desirable with the flattest on which all efficient portfolios would lie.

The implications for mutual fund performance are that if mutual funds hold efficient portfolios they would all have E/$\bar{\sigma}$ points along a straight line. Furthermore,to the extent that some funds are not efficient they would give E/$\bar{\sigma}$ points along lines further to the left. Since all lines

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[6]Note that E is plotted as the dependent variable and that $(E_i-p)/\bar{\sigma}_i$ is actually the reciprocal of the slope.

originate at p their direction depends on $(E_i-p)/\sigma_i$, lower values of which ratio would be associated with inferior performance. This is logical as the ratio represents the expected return (over and above that obtainable on a riskless investment) per unit of risk assumed. Sharpe refers to this as the R/V, reward to variability ratio.

We can now explore to what extent, if at all, the conditions derived from the theory hold in practice. Specifically we will investigate the following hypotheses (1) greater variability in yields is associated with higher average yields,(2) there is a significant relationship between average yield and variability which is approximately linear, (3) differences in performance persist through time, (4) funds attempt to remain in given risk classes, as measured by variability in yield, (5) the average Canadian mutual fund performs as well as a portfolio like the Toronto Stock Exchange Industrial Average.

Similar research has previously been carried out by Sharpe[7] for U.S. mutual funds whereas this study focuses on Canadian funds.

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[7]William F. Sharpe, "Risk Aversion in the Stock Market: Some Empirical Evidence," Journal of Finance, (September, 1965), pp. 416-422.

William F. Sharpe, "Mutual Fund Performance," Journal of Business, Vol. XXXIX (January, 1966), p. 119.

CHAPTER 2

METHODOLOGY

Since there is no way of obtaining the E/σ values predicted by our investors, ex post values had to be used as proxies for the ex ante ones. The average rate of return[8] (A_i) of each portfolio was therefore used as an estimate of its expected rate of return (E_i); and the standard deviation[9] of the yield (V_i) to estimate predicted risk (σ_i) for twenty-two open-end mutual funds during the period 1954-1969. The funds were selected so as to include those for which annual rates of return had been reported for sixteen years. The sample of funds was drawn to include at least one fund from each category of Balanced funds, Common stock funds, Fully managed funds, Specialty funds, Bond Funds and Trust Company Funds. Excluded were non-resident owned funds so as not to vitiate the analysis of performance of Canadian funds

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[8]The actual rate of return on a portfolio is the average of the rates of return of its component securities. The A_i values for the study were averaged over the eight year periods of the changes in net asset values reported in the Financial Post Survey of Investment Funds, 1962 and 1970. Calculations made by the Financial Post Survey assume that all dividends and distributions have been reinvested and their result is expressed as percentage change in net assets per share.

[9]Computed as the square root of the sums of the squared deviations divided by (n-1).

in comparison with foreign owned funds.

In the context of the theory, the pure interest rates for the periods 1962-1969 and 1954-1961 should have been taken as the yield on eight year Canadian government bonds issued in the years 1961 and 1953 respectively, and held to maturity. It was not apparent from Sharpe's[10] study what type of bond was selected. The pure interest rate p (= 3.5 percent) for the current study was determined by averaging the yields of bonds of all types and counter-checking with the average yield of funds investing in Canadian bonds only. Since the long term interest rate during the previous period was slightly less, the pure interest p was fixed at 3.0 percent.[11]

Regression analysis was used to establish the underlying linear relationship of the funds. The reward to variability ratio $(A_i-p)/V_i$ for the two periods 1954-1961 and 1962-1969 was used as an index to predict the performance during the latter, 1962-1969 period from the reward to variability ratio of the earlier period.

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[10] Ibid., p. 123.

[11] A sensitivity analysis on p resulted in changes in the ranks (based on reward to variability ratio) of some of the funds. Nevertheless, (1) greater variability was associated with higher yield, (2) there was a significant and approximately linear relationship between average yield and variability, and (3) differences in performance generally persisted through time. These indicators of mutual fund performance are thus relatively insensitive to assumptions regarding the pure interest rate over a 3 to 6 percent range.

The reward to variability ratio (R/V) represents the expected return (E_i) per unit of risk assumed (σ_i). It accordingly is an index of the reward (A_i-p) obtained from the fund and the risk actually experienced (V_i). Our investor is interested in this relationship in order to complement the risk implicit in fund i. He can do this by borrowing additional funds or by investing in some riskless security. However, to be able to make such a decision, he must have some idea of the variability (V_i),the fund will actually experience. The variability of the fund will depend on the risk class management sustains over a period of time. To test the consistency over time with regard to variability of returns, rank coefficient of correlation was used.

Lastly, the distribution of the ratios for the period 1962-1969 was contrasted with Toronto Stock Exchange Industrial Average as an indicator of efficiency of management in selecting its portfolios. All these analyses in combination were used to evaluate mutual fund performance.

CHAPTER 3

EMPIRICAL RESULTS

The results of the study using Canadian data corroborated those of the original study. Each of the hypotheses relating to (1) association of average yields and variability in yields, (2) underlying relationship between yield and variability, (3) differences in performance, (4) consistency of risk classes, and (5) comparison of fund performance with the Toronto Stock Industrial Average; is dealt with separately below:

3.1 Average Yield and Variability

The values obtained for average annual rate of return (A_i) over eight years and the corresponding standard deviation of annual rate of return (V_i) for each of the twenty-two selected funds are shown in Table 1. The consistency of relationship between yield and risk predicted by the theory of capital asset prices is apparent from Figure 1. The correlation coefficient +.717 is significant[12] and consistent with the assumption of risk-aversion. Funds with large average returns depict greater variability than those with smaller yields.

The market process by which A and V values would

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[12] A coefficient of .45 is significant at p = .01; t-value of slope of regression line is 4.601.

tend to follow a linear relationship would involve changes in the prices of capital assets; the price changes in turn would alter the mean and standard deviation of the annual yield. Since, neither A nor V can be considered an independent variable, the appropriate line for estimating their relationship probably lies somewhere between the two regression lines obtained by regressing V on A and A on V. The equations of the three lines (Figure 2) are:

Regression V on A: $V = 3.204 + 1.296A$
Regression A on V: $A = 2.240 + 0.396V$
Intermediate line: $V \doteqdot 0.700 + 0.846A$

The p value given by the intermediate line means that investors required and received an annual rate of return of about 0.7 per cent on riskless assets. To take on risk, they required and received an additional 0.85 per cent of expected return per annum for each 1 per cent of predicted standard deviation of annual return, i.e. risk. Thus the relationship between yield and variability as anticipated by the theory is affirmed; funds providing greater average returns experience greater variability. These values may or may not reflect the conditions prevalent in the capital market during the period 1962 to 1969. Even in case they do reflect current market conditions, they may not reflect the underlying trend for future prediction. The apparent trend of linearity is analysed in the succeeding section.

3.2 Linear Relationship between Yield and Variability

As already pointed out, if an investor's funds can be divided between a risky portfolio and an investment at the pure interest rate; he can obtain any combination of A and V on the line connecting the point representing the A, V combination of the risky portfolio, and the point representing the A, V combination obtained with the pure interest rate. If the investor is able to borrow funds at the same rate of interest, any point on the extension of the line for higher values of A and V would also be attainable. Under these conditions all efficient portfolios must lie along a straight line passing through the point representing the pure interest rate. Although the relationship shows a linear trend (Figure 1), investors are normally not able to borrow extensively at the pure interest rate to purchase risky assets, the relationship may not be linear especially as higher values of A and V are reached.

3.3 Persistence of differences in Performance

As a measure of differences in performance through time, R/V ratios of the same twenty-two funds were calculated for the period 1954-1961 and are shown in Table 2. The funds were ranked according to their R/V ratios (Table 3) for both periods. The corresponding points were then plotted in Figure 3. The relationship between R/V ranks in the two periods is suggestive of an upward trend. Some of the funds

with high ranks in the earlier period also have high ranks in the later period. However, others do not. The value of the Spearman rank coefficient of correlation (+.286) validates the positive relationship as does also the count of points falling in the four quadrants. An investor selecting one of the eleven best funds in the first period would have had a 7:4 chance of retaining one of the eleven best in the second period, and vice versa. Simple regression of the R/V values also bears this out: the correlation coefficient is +0.204 and the t-value for the slope coefficient is +0.933. Thus differences in performance as measured by the R/V ratio appear to persist through time and could therefore be used for prediction. However, they would not be perfect predictors. Also we do not know the source of such differences.

3.4 Risk Classes of Mutual Funds

To be able to compensate adequately for the risk inherent in a particular portfolio, investors expect funds to show reasonable consistency over time with regard to variability of returns. The scatter of various risk classes plotted in Figure 4 shows consistency over time. The funds were ranked (Table 4) for the two periods studied 1962-1969 and 1954-1961 - rank one indicating the largest variation and rank twenty-two the smallest. Although the underlying relationship appears to be consistent, there are a number of shifts in ranks, either because of change in managerial

policy or inadvertently. There being no standard available for comparison, it was concluded that management generally stay within their selected risk class.

3.5 Mutual Funds Versus Toronto Stock Industrial Average

The Toronto Stock Industrial Average was used as an alternative strategy for investing in a reasonably diversified portfolio of eighty-seven securities. When calculating the average returns from the Toronto Stock portfolio, no brokerage, management or administrative costs are deducted. From mutual funds returns likewise, the initial selling (load) charges are not deducted; thus the returns from both types of investments are overstated.Figure 5 shows the distribution of R/V ratios for the twenty-two funds for the period 1962-1969 and also the R/V ratio of the Toronto Stock Average at +0.300. The average R/V ratio for the funds in the sample was 0.269 - smaller than the Toronto Stock Average. Obviously the results for another sample of funds might differ from these. However, for this sample the odds are greater than 5 to 1 against the possibility that the average mutual fund did as well as the Toronto Stock portfolio between 1962 and 1969.[13] In this sample ten funds did better than the

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[13] The standard deviation of the R/V values for the 22 funds was +0.194. If the population of the mutual funds had a mean of +0.300 and a standard deviation of +0.194, the distribution of the sample means for groups of 22 would have a standard deviation of +.040 ($=0.194/22^{1/2}$) and be roughly normally distributed. The observed mean of +0.269 is +0.78 standard deviations below the assumed mean of +0.300; the odds are 5 to 1 that under the hypothesized conditions, a sample of 22 funds would have an average R/V value as low as +0.269.

Toronto Stock portfolio while twelve did worse. A comparison of gross figures with that of the Toronto Stock Industrial Average could not be made because expense figures for the selected funds were not available on a similar basis for all the funds in the sample. However, one would expect that the average mutual fund manager could select a portfolio as good as the Toronto Stock Industrials, but that the net return (after costs associated with the operation of the fund have been deducted) would fall short of those from the Toronto Stock portfolio.

CHAPTER 4

CONCLUSIONS

In this study an attempt has been made to evaluate a measure of mutual fund performance with Canadian data. The starting point has been traced to the theoretical development of a model by Sharpe for the measurement of mutual fund performance. The author based his work on advances in capital market theory and the behavior of stock market prices. Its validity rests on the conditions that yield and variability or risk are the key variables; that investors are risk averters, that investors can invest and borrow at a risk-free interest rate, and finally that investors share similar predictions concerning the future performance of securities.

This empirical study using Canadian data has shown that average annual yield and its variability are interrelated, funds with larger average returns show greater variability than those with smaller yields. Also, the underlying relationship is approximately linear and significant. These results do not by themselves provide an explanation of the persistence of differences in performance over a period of time.

To analyze the differences, a single measure of performance including both the average return and risk as its components - the reward-to-variability ratio showed that differences in performance persist through time. Thus the

index provides an indication of the continuation of differences though not perfectly but does not indicate the source of such differences.

An investigation into the risk element of fund management showed that whereas reasons for shifts in risks levels cannot be determined, management generally stay within their selected risk class. Such consistency in the risk classes is useful for the investors to complement the risk component by rearranging his other commitments by borrowing or investing in a riskless security.

Lastly, a comparison with Toronto Stock Industrial Average revealed that the average mutual fund net of costs did not do quite as well as the Toronto Stock Industrial Average.

From the analyses, it is apparent that fund performance can be evaluated with a measure of performance that combines average return and risk into a single index. However, generalizations regarding the performance of funds cannot be made from such an index. A fundamental difficulty is encountered in the measurment of yield and risk variables. Estimates of mean and standard deviation derived from a single small sample cannot be considered representative of the true value of these variables for the fund. Further, it may not be possible to predict future yields reliably because fluctuations in purchasing power make real yield greater or lesser. Comparisons between two portfolios on the basis of risk and yield may not be dependable.

Liquidity which is important from the investor's viewpoint has been left out of the index. Liquid reserves which have to be maintained by managers of mutual funds are not likely to provide a high yield and therefore are obtainable at a cost. Also, even if investors are able to borrow at a risk free interest rate; the choice between savings bonds and bank certificates as risk free assets is likely to lead to different ranks.[14]

Sharpe's analyses must be viewed in the light of these limitations. It is also interesting to note that Horowitz[15] by weighting funds according to stated management objectives and similar analyses, concluded that "merely knowing the fund's investment objectives permits one to explain overall differences in R/V about as well as does knowledge of the other variables considered by Sharpe. . . ." Further research is needed before these results can be used for prediction of mutual fund performance.

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[14]G. D. Quirin, and W. R. Waters, A Study of the Canadian Mutual Funds Industry (Toronto: The Canadian Mutual Funds Association, 1969), p. 21.

[15]I. Horowitz, "The Reward to Variability Ratio and Mutual Fund Performance," Journal of Business, Vol. XXIX (October, 1966), p. 487.

TABLE 1

PERFORMANCE OF 22 MUTUAL FUNDS, 1962-69

Mutual Fund	Average Annual Return (A_i) %	Variability of Annual Return (V_i) %	Reward-to-Variability Ratio R/V*
1. American Growth	9.5	22.3	0.26941
2. Associate Investors	7.1	12.8	0.28320
3. Beaubran Corporation	7.4	11.5	0.33803
4. Canada Trust Equity	9.9	11.1	0.57553
5. Canada Trust Fixed Income	2.5	2.8	-0.36004
6. Canadian Anaesthetists	9.6	14.8	0.41485
7. Canadian Investment Fund	7.0	9.9	0.35407
8. Canafund Company	7.9	11.8	0.36997
9. Champion Mutual	5.9	12.1	0.19628
10. Commonwealth International	9.2	12.2	0.47049
11. Commonwealth Intl. Leverage	12.0	21.3	0.39918
12. Corporate Investors	5.5	9.4	0.21390
13. Dominion Compound	3.9	10.4	0.03611
14. Dominion Equity	9.0	10.9	0.50328
15. Fond Collectif A	4.6	13.0	0.08622
16. Grouped Income Shares	7.1	16.1	0.22513
17. Investors Growth	9.2	13.3	0.43211
18. Investors Mutual	6.0	9.9	0.25144
19. Mutual Accumulating	5.6	11.3	0.18868
20. Savings & Investment	5.6	11.2	0.18997
21. Timed Investment	5.2	10.2	0.17213
22. United Accumulative	9.2	18.7	0.30751

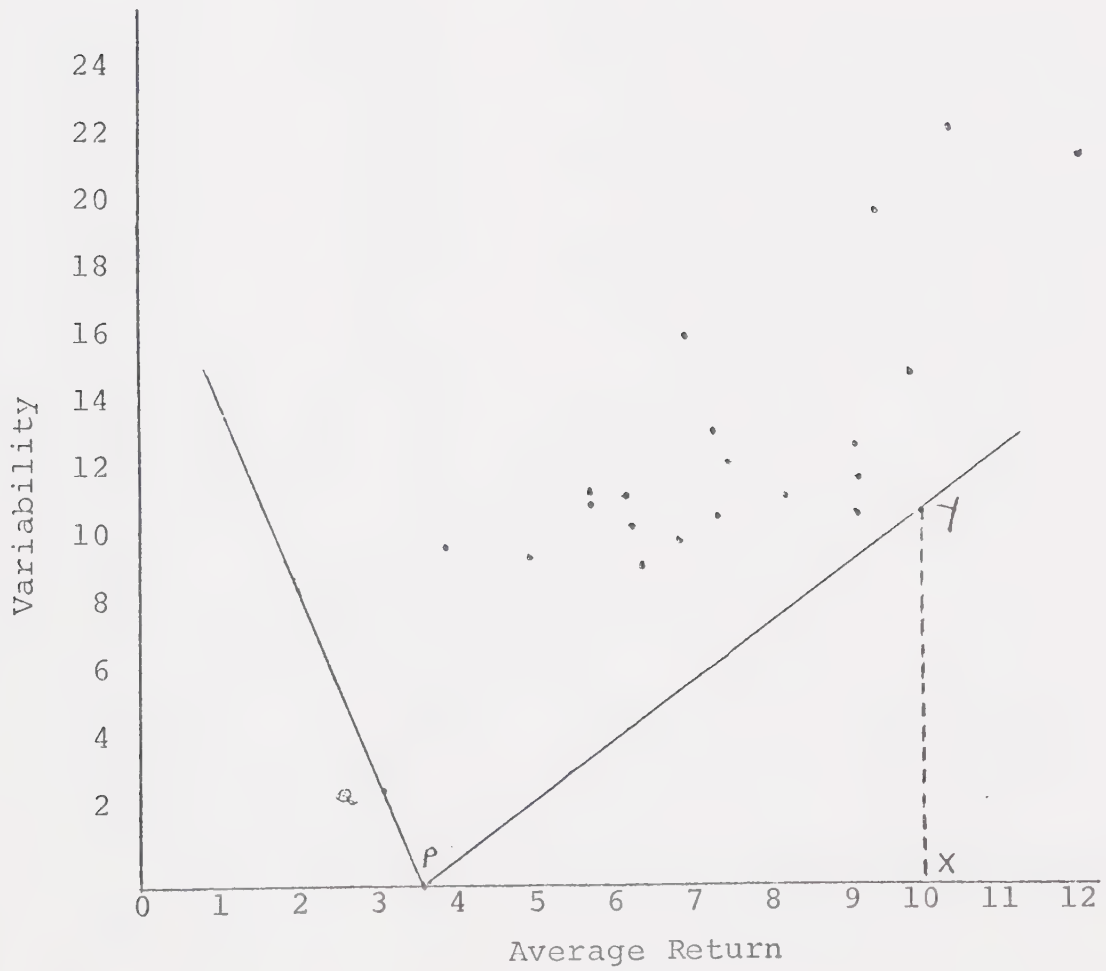
*R/V ratio = (average return -3.5 percent)/variability.

Source: Financial Post Survey of Investment Funds, 1970.

Program Detail in Appendix A.

FIGURE 1

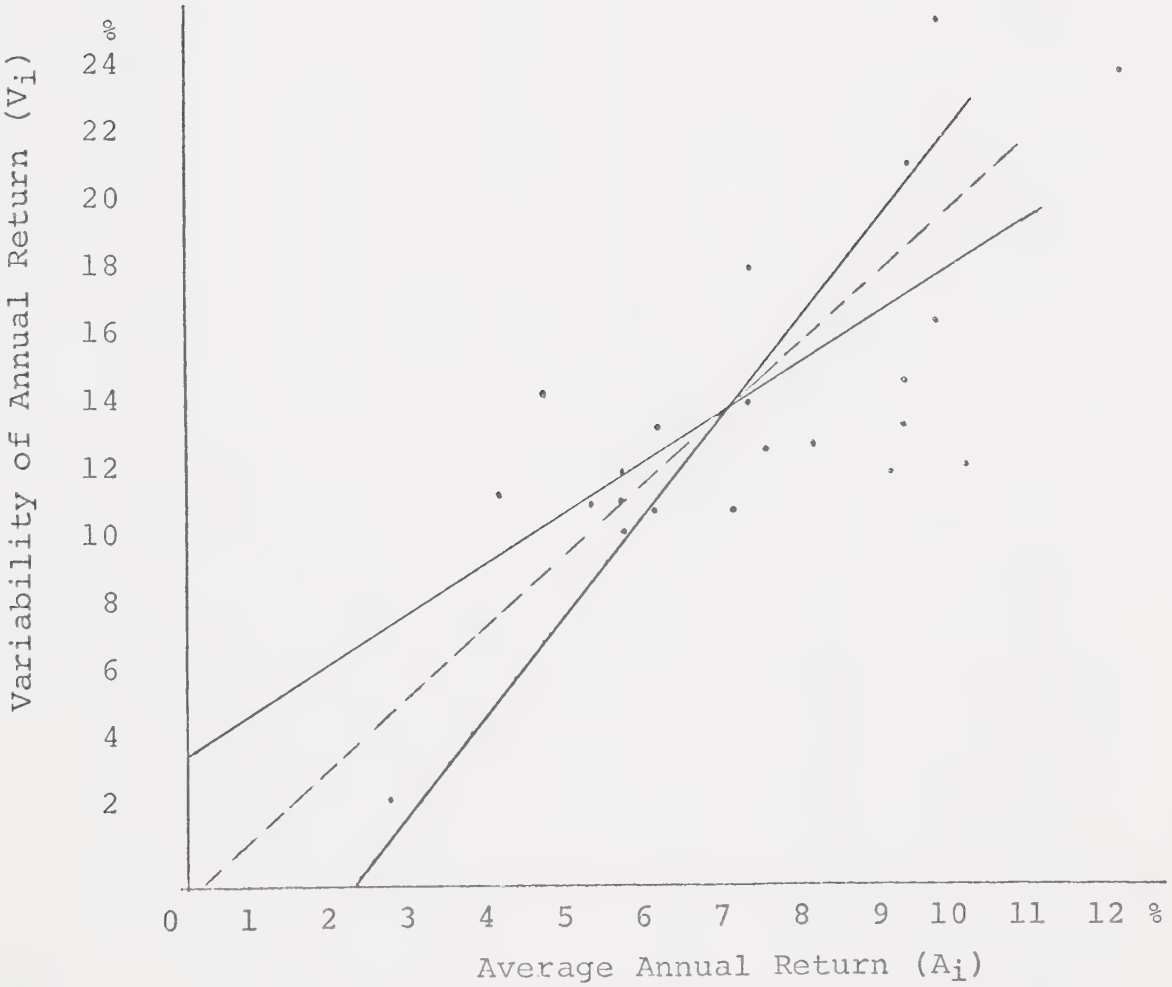
AVERAGE RETURN AND VARIABILITY
22 OPEN END MUTUAL FUNDS, 1962-1969



Program Detail in Appendix A.

FIGURE 2

REGRESSION LINES:
AVERAGE RETURN AND VARIABILITY
22 OPEN END MUTUAL FUNDS, 1962-1969



Program Detail in Appendix A.

TABLE 2

PERFORMANCE OF 22 MUTUAL FUNDS, 1954-61

Mutual Fund	Average Annual Return (A_i) %	Variability of Annual Return (V_i) %	Reward-to-Variability Ratio R/V*
1. American Growth	17.8	23.6	0.62586
2. Associate Investors	13.2	16.3	0.63025
3. Beaubran Corporation	9.7	12.2	0.55391
4. Canada Trust Equity	6.0	18.2	0.16440
5. Canada Trust Fixed Inc.	4.7	4.0	0.41239
6. Canadian Anaesthetists	8.7	9.3	0.61676
7. Canadian Investment Fund	13.2	16.0	0.64036
8. Canafund Company	14.1	17.8	0.62458
9. Champion Mutual	7.3	14.1	0.30713
10. Commonwealth International	14.2	19.6	0.57373
11. Commonwealth Intl. Leverage	17.9	25.5	0.58339
12. Corporate Investors	13.4	16.0	0.64882
13. Dominion Compound	5.3	17.9	0.13017
14. Dominion Equity	8.4	11.3	0.47406
15. Fond Collectif A	8.8	11.0	0.52684
16. Grouped Income Shares	14.0	20.5	0.53547
17. Investors Growth	12.5	13.4	0.71006
18. Investors Mutual	14.1	14.5	0.76539
19. Mutual Accumulating	13.5	17.0	0.61811
20. Savings & Investment	8.8	13.5	0.42851
21. Timed Investment	8.8	13.7	0.42707
22. United Accumulative	17.0	14.5	0.96304

*R/V ratio = (Average return -3.0 percent)/variability.

Source: Financial Post Survey of Investment Funds, 1961.

Program Detail in Appendix A.

TABLE 3

RANKS OF 22 MUTUAL FUNDS

Based on $R/_V$ Ratios

Mutual Fund	Rank 1962-1969	Rank 1954-1961
1. American Growth	12	7
2. Associate Investors	11	6
3. Beaubran Corporation	9	13
4. Canada Trust Equity	1	21
5. Canada Trust Fixed Income	22	19
6. Canadian Anaesthetists	5	10
7. Canadian Investment Fund	8	5
8. Canafund Company	7	8
9. Champion Mutual	16	20
10. Commonwealth International	3	12
11. Commonwealth Intl. Leverage	6	11
12. Corporate Investors	15	4
13. Dominion Compound	21	22
14. Dominion Equity	2	16
15. Fond Collectif A	20	15
16. Grouped Income Shares	14	14
17. Investors Growth	4	3
18. Investors Mutual	13	2
19. Mutual Accumulating	18	9
20. Savings & Investment	17	17
21. Timed Investment	19	18
22. United Accumulative	10	1

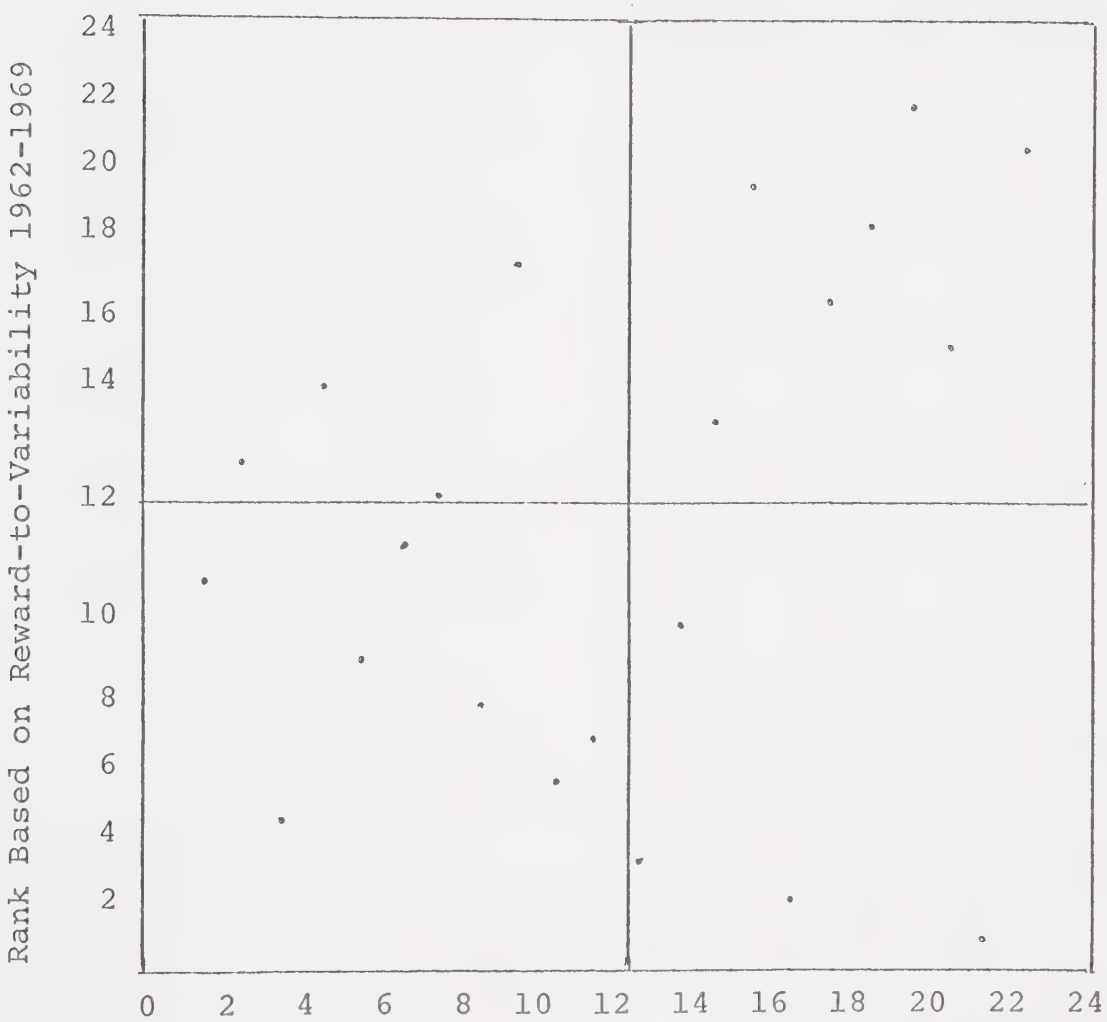
Spearman's Rank Coefficient of Correlation

$$r = 1 - 6 \sum_{i=1}^{n} di^2/n(n^2-1)$$

Program Detail in Appendix A.

FIGURE 3

PREDICTIONS BASED ON
REWARD-TO-VARIABILITY RATIO



Rank Correlation Coefficient = +.286.

Worst	4	7
Best	7	4
	Best	Worst

TABLE 4

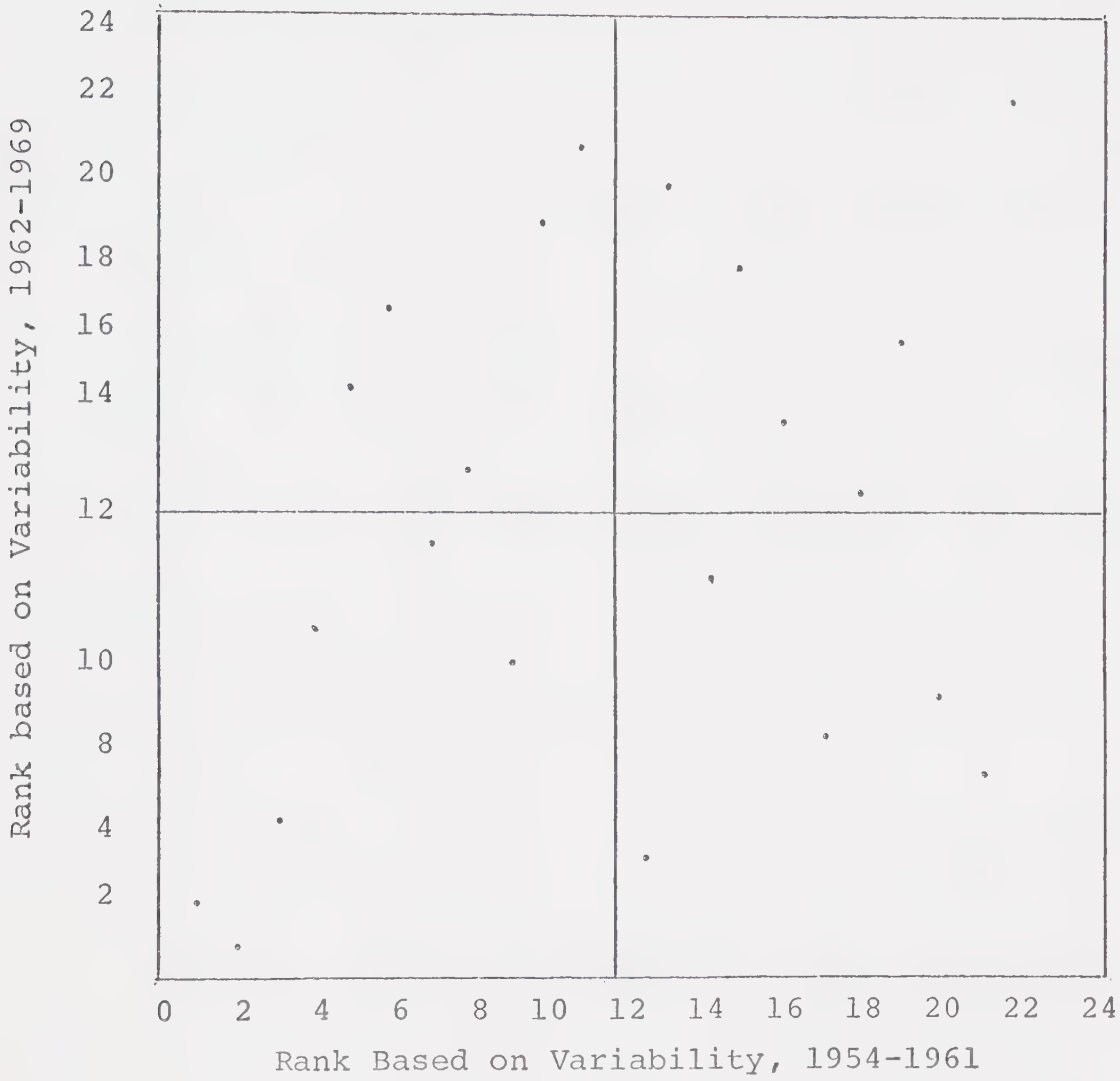
RANKS OF 22 MUTUAL FUNDS

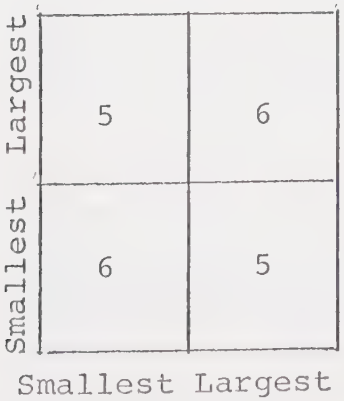
Based on Variability

Mutual Fund	Rank 1962-1969	Rank 1954-1961
1. American Growth	1	2
2. Associate Investors	8	9
3. Beaubran Corporation	12	15
4. Canada Trust Equity	15	5
5. Canada Trust Fixed Income	21	19
6. Canadian Anaesthetists	5	18
7. Canadian Investment Fund	19	10
8. Canafund Company	11	7
9. Champion Mutual	10	12
10. Commonwealth International	9	4
11. Commonwealth Intl. Leverage	2	1
12. Corporate Investors	20	10
13. Dominion Compound	17	6
14. Dominion Equity	16	16
15. Fond Collectif A	7	17
16. Grouped Income Shares	4	3
17. Investors Growth	6	14
18. Investors Mutual	19	11
19. Mutual Accumulating	13	8
20. Savings & Investment	14	13
21. Timed Investment	18	12
22. United Accumulative	3	11

FIGURE 4

CONSISTENCY OF RISK CLASS

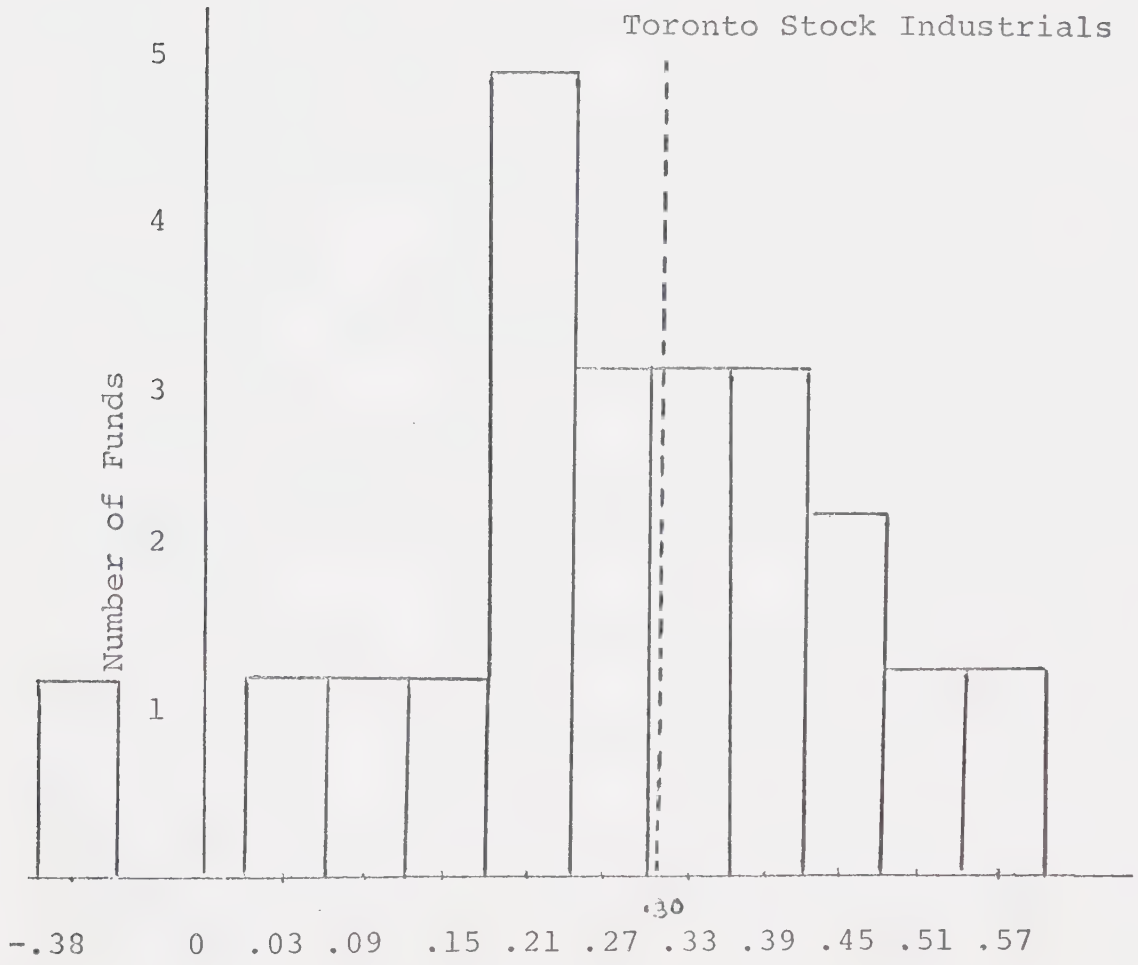




Rank Correlation
Coefficient = +.542

FIGURE 5

MUTUAL FUND PERFORMANCE VERSUS
TORONTO STOCK INDUSTRIALS



Source: Bank of Canada Supplements 1969, 1968
for Toronto Stock Industrial Averages

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APPENDIX A

PERFORMANCE OF 22 MUTUAL FUNDS

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      Dimension name (22,6),IX (22,8),IY(22,8),NX(22), AX(22),
     1AY(22),SX(22),SY(22),RX(22),RY(22),JX(8),JY(8),X(8),Y(8)
     1,RRX(22),RRY(22)
      DO 100 I=1,22
      READ(5,1)(name(I,J),J=1,6),JX,NX(I)JY,NY(I)
    1 FORMAT(6A4,8I3,I1,8I3,I1)
      DO 101 K=1,8
      X(K)=JX(K)
      Y(K)=JY(K)
      IX(I,K)=JX(K)
  101 IY(I,K)=JY(K)
      CALL CS223A(X,NX(I),0,0.0,NV,AX(I),V,SX(I),1)
      RX(I)=NAX(I)-3.)/SX(I)
      CALL CS223A(Y,NY(I),0,0.0,NV,AY(I),V,SY(I),1)
  100 RY(I)=(AY(I)-3.5)/SY(I)
      WRITE(6,2)
    2 FORMAT('1',40X,'DATA 1954-1961'/
     136X,'1961  1960  1959  1958  1957  1956  1955  1954'///)
      DO 102 I=1,22
      NN=NX(I)
      WRITE(1,3)(NAME(I,J),J=1,6),(IX(I,K),K=1,NN)
    3 FORMAT(10X,6A4,8I6)
  102 CONTINUE
      WRITE(6,10)
   10 FORMAT('1',40X,'DATA 1962-1969'/
     136X,'1969  1968  1967  1966  1965  1964  1963  1962'///)
      DO 103 I=1,22
      NN=NY(I)
      WRITE(6,3)(NAME(I,J),J=1,6),(IY(I,K),K=1,NN)
  103 CONTINUE
      CALL RANK(RX,RRX,22)
      CALL RANK(RY,RRY,22)
      WRITE (6,4)
    4 FORMAT('1',10X,'PERFORMANCE OF 22 FUNDS, 1954-1961'///)
      WRITE(6,7)
    7 FORMAT (
     135X,'  AVERAGE   VARIABILITY'/
     135X,'   ANNUAL   OF ANNUAL   REWARD-TO-'/
     135X,'   RETURN   RETURN      VARIABILITY'/
     135X,'(PER CENT)  (PER CENT)  RATIO(R/V)          RANKS'///)
      DO 104 I=1,22
      WRITE(6,6)(NAME(I,J),J=1,6),AX(I),SX(I),RX(I),RRX(I)
    6 FORMAT(10X,6A4,2F10.1,F14.5,F14.2)
  104 CONTINUE
      WRITE(6,5)
    5 FORMAT('1',10X,'PERFORMANCE OF 22 FUNDS, 1962-1969'///)
      WRITE(6,7)
```

APPENDIX A (continued)

```
      DO 105 I=1,22
      WRITE(6,6)(NAME(I,J),J=1,6),AY(I),SY(I),RY(I),RRY(I)
105   CONTINUE
      DO 106 I=1,22
      WRITE (8,8)AX(I),SX(I),RX(I),RRX(I),AY(I),SY(I),RY(I),
                                                    RRY(I)
    8 FORMAT(8F10.5)
106   CONTINUE
      WRITE(6,9)
```

APPENDIX A

DATA ON OPEN END FUNDS*

(Annual Percent change in Net Assets Per Share)

1. American Growth	A**	-19,8,39,-6,35,13,23,-17
	B***	27,3,19,51,-11
2. Associate Investors	A	0,25,-1,-10,5,24,15,-1
	B	29,-5,6,27,-6,2,17,36
3. Beaubran Corporation	A	-2,24,9,-8,4,21,13,-2
	B	23,4,1,20,-9,1,14,24
4. Canada Trust Equity	A	1,13,22,-4,6,23,20,-2
	B	27,-3,-6
5. Canada Trust Fixed Income	A	-1,2,0,1,1,6,6,5
	B	7,7,0
6. Canadian Anaesthetists	A	-6,23,32,-7,10,18,13,-6
	B	21,1,2,11
7. Canadian Investment Fund	A	1,19,12,-8,3,18,13,-2
	B	27,2,2,24,-10,4,20,37
8. Canafund Company	A	2,22,14,-6,3,24,11,-7
	B	31,2,1,31,-13,5,20,36
9. Champion Mutual	A	-4,20,12,-11,6,18,14,-8
	B	20,0,3,27,-12,6
10. Commonwealth International	A	10,26,19,-10,4,16,14,-5
	B	21,0,9,30,-15,2,19,48
11. Commonwealth Intl. Leverage	A	-6,42,40,-10,10,19,14,-13
	B	28,1,10,56,-21,0,23,46
12. Corporate Investors	A	-6,16,15,-6,2,14,10,-1
	B	21,4,3,29,-11,5,18,38
13. Dominion Compound	A	-4,18,9,-8,-1,15,10,-8
	B	26,-6,-4
14. Dominion Equity	A	-1,23,17,-7,6,18,16,0
	B	15,-4,19,-6,-3,18,21,7
15. Fond Collectif A	A	-15,26,6,-7,2,15,12,-2
	B	25,3,3,15,-2
16. Grouped Income Shares	A	-14,22,26,-14,8,16,18,-5
	B	21,-7,6,33,-17,8,23,45
17. Investors Growth	A	-7,22,25,-4,12,19,14,-7
	B	26,-3,6,21
18. Investors Mutual	A	-6,15,16,-5,6,16,11,-5
	B	21,5,4,28,-8,7,20,36
19. Mutual Accumulating	A	-11,13,10,-4,7,19,17,-6
	B	25,1,4,25,-12,5,19,41
20. Savings & Investment	A	-10,17,16,-7,4,17,11,-3
	B	27,2,1,19,-5
21. Timed Investment	A	-1,23,3,-9,2,16,8,0
	B	21,5,3,30,-5,-1
22. United Accumulative	A	-18,9,36,-7,15,28,18,-7
	B	31,3,6,28

*Financial Post Survey.
Excludes annual returns not available or < 1%.
**A = 1962-1969. ***B = 1954-1961.

APPENDIX A

SPEARMAN RANK COEFFICIENT

```
      DIMENSION X(22),Y(22),R(44)
      NR=0
      N=22
      WRITE(6,1)
    1 FORMAT('1DATA')
      DO 100 I=1,N
      READ(8,2)X(I),Y(I)
    2 FORMAT(20X,F10.5,30X,F10.5)
  100 WRITE(6,3)X(I),Y(I)
    3 FORMAT(1X,2F10.5)
      CALL SRANK(X,Y,R,N,RS,T,NDF,NR)
      WRITE (6,4)RS,T,NDF
    4 FORMAT(///10X,'SPEARMAN RANK CORRELATION =',F8.4/
     110X,'STUDENT T =',F12.4/
     110X,'NUMBER OF DEGREES OF FREEDOM =',I3)
      DF=NDF
      CALL CS204A(T,DF,P,IER)
      IF (P.GT.0.5)P=1.-P
      P=2.*P
      WRITE(6,5)P
    5 FORMAT(10X,'TWO-TAILED PROBABILITY =',F7.4)
      STOP
      END
```

APPENDIX A

CONTROLE REGRESSION

```
      DIMENSION X(22),Y(22),XX(22),YY(22), XY(22)
      SX=0.
      SY=0.
      SXX=0.
      SYY=0.
      SXY=0.
      WRITE (6,3)
    3 FORMAT('1', 9X,'   x   y   xx   yy   xy')
      DO 100 I=1,22
      READ(8,1)X(I),Y(I)
    1 FORMAT(20X,F10.5,30X,f10.5)
      XX(I)=XNI)**2
      YY(I)=Y(I)**2
      XY(I)=X(I)*Y(I)
      SX=SX+X(I)
      SY=SY+Y(I)
      SXX=SXX+XX(I)
      SYY=SYY+YY(I)
      SXY=SXY+XY(I)
      WRITE(6,2)x(I),Y(I),XX(I),YY(I),XY(I)
    2 FORMAT(10X,2F6.1,3F8.2)
  100 CONTINUE
      WRITE (6,4) SX,SY,SXX,SYY,SXY
    4 FORMAT (5X,'sum',2X,2F6.1,3F8.2)
      SSDX=22.*SXX-SX**2
      SSDY=22.*SYY-SY**2
      SPD=22.*SXY-SX*sy
      WRITE (6,5) SSDX,SSDY,SPD
    5 FORMAT(10X,'NSSDX',F15.4,' NSSDY',F15.4,' NSPD',F15.4)
      R=SPD**2/(SSDX*SSDY)
      R=SQRT(R)
      WRITE(6,6)R
    6 FORMAT(10X,'R =',F10.4)
      B=SPD/SSDX
      A=(SY-B*SX)/22.
      SYX=(1.-R*R)*SSDY/440.
      C=SYX*22./SSDX
      C=SQRT(C)
      WRITE (6,7)B,A,C
    7 FORMAT(10X,'B',F10.4,' A',f10.4,' STANDARD ERROR OF B',
                                                    F10.4)
      PL=B-2.086*C
      PR=B+2.086*C
      WRITE(6,8)PL,PR
    8 FORMAT(10X,'CONFIDENCE LIMITS(95%)',2F12.4)
    9 FORMAT(10X,'CONFIDENCE LIMITS(98%)',2F12.4)
```

APPENDIX A (continued)

```
PL=B-2.528*C
PR=B+2.528*C
WRITE(6,9)PL,PR
STOP
END
```